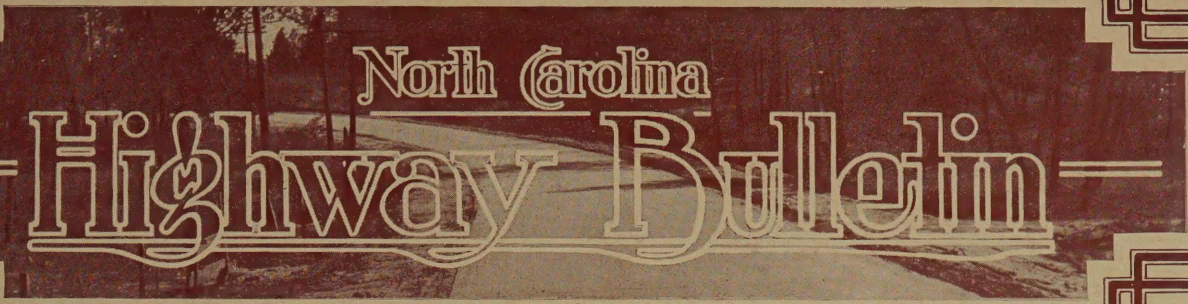

North Carolina Highway Bulletin

VOL. III NOVEMBER-DECEMBER, 1922 NOS. 9-10

WILMINGTON-CHARLOTTE-ASHEVILLE HIGHWAY-BRUNSWICK COUNTY

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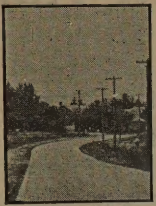

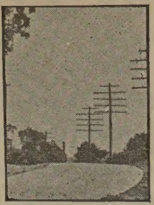

NORTH CAROLINA
HIGHWAY BULLETIN

Vol. III, Nos. 9-10 **H. K. WITHERSPOON, Editor** **NOVEMBER-DECEMBER 1922**

Locating *and* Mapping Highways *in* North Carolina

By GEORGE F. SYME, *Senior Highway Engineer*

HIGHWAY location is costing less than a hundred dollars a mile in North Carolina. Including plans for construction the average cost is $117 a mile. These low costs are due to a very painstaking effort to standardize practice and to centralize control. The new methods have been employed only since the first of 1922, but they are the outgrowth of six years of study and experimentation.

Originally all surveys in a given district were conducted under the direct supervision of the district engineer, and the plans and preliminary estimates were prepared in the district offices. It appeared on study that plans could be more economically prepared at the main office in Raleigh; a large overhead expense was saved, and forces of draftsmen in the nine district offices were eliminated. A drafting force was therefore assembled at headquarters, under a chief draftsman, and divided into several squads of five men each,—one man in each squad serving as squad leader. It handled the field survey notes from all the districts and prepared plans, profiles and estimates.

It was next found necessary to standardize the methods of keeping field notes and other records. A notable reduction in the cost of preparing plans was at once observed.

When a survey of a given project was completed the locating party often was assigned to the construction. This was due largely to the urgent and immediate need for construction men. The important thing was, however, that when a new survey was ordered a new locating party had to be organized and put in the field. No experienced locating engineers were being developed.

Sectional Surveys

Based on its success in centralizing the drafting work, the commission finally concluded to reorganize its location forces with a view first to developing skilled locators, thus obtaining better locations and reductions in the construction and operating costs, and second, to reduce the cost per mile of making the surveys. A department of location was created and a principal locating engineer was appointed with headquarters at Raleigh. This department took over all location parties then in the field—about 26 in number. These parties were reorganized, so as to consist of a chief of party, transitman, levelman, front rodman, level rodman, chainman, stakeman, and axeman as needed. The front rodman serves as chainman, making seven men to the party, plus the axemen necessary.

The State was divided into three survey sections, i. e., Coastal, Piedmont and Mountain, and each section was placed in charge of an experienced locating engineer, reporting directly to the principal locating engineer at Raleigh. All of the party chiefs in a given section report to the locating engineer in charge of that section.

By these various changes the efficiency of the parties has been so increased that it has been possible to reduce their number from 26 to 14 and a further reduction to 12 parties is anticipated. This large reduction, however, was not wholly due to increased efficiency, but was partly owing to the fact that the reorganization disclosed that more men were in the field than were needed.

Before the organization of locating department the average mileage of completed location per month, per party, was 6.7 miles and the average cost of making it including all necessary preliminary surveys, subsistence, transportation, etc., was $110 per mile.

Under the present organization the average number of miles finally located per party per month is 9.7 miles, and the average cost, including all necessary preliminary surveys and all other expenses is $92 per mile, and further improvement is anticipated.

Gratifying as are the numerical results, they pale into insignificance when one attempts to compare the results, in the larger aspects, of locations made by untrained men, with those made by locating parties who devote their whole time and thought to location and who become specialists in that class of work. Large reductions in the first cost of construction have been obtained, and bet-

(Continued on page 10)

The Proper Treatment *of* Posts *for* Guard Rails

By EDWARD F. PADDOCK

GUARD rail posts are exposed to particularly severe conditions and are subject to a number of dangerous and very contagious diseases known collectively and indiscriminately as rot or decay. Rot in timber is caused by the presence of fungi, or as they are more commonly called toadstools or mushrooms. These are plants of a low order that grow not on but in the wood. Like other plants, they grow from seed, but from seed so small as to be invisible to the naked eye, except in masses. These seeds or spores are in the air at all times and are washed down by the rain or dew, so that the moisture that comes in contact with posts is full of them.

When one of these spores is deposited on a piece of wood, under suitable conditions it germinates and begins to grow in the wood, sending out a network of threads which find their food in the substance of the wood, just as a plant takes nourishment from the soil. To all outward appearances the wood is unchanged, but beneath the surface the fungus is taking away certain constituents of the wood and leaving it a mass of soft material that we know as rotten wood.

Four Conditions Neccessary for Decay

When the fungus reaches maturity its next business is the reproduction of its kind and it is only then that we become aware of its presence. It begins to bear fruit. This fruit appears on the surface of the wood in the form of toadstools, mushrooms, punks or conks, which soon begin scattering seeds by the million and the process begins again.

Like all other plants, fungi require moisture, air, a suitable temperature and food. Remove any one of these essentials and the fungus cannot develop. In the case of guard-rail posts, however, these conditions are not within our control. The post is set in the ground where it is almost continually damp and where the moisture in the wood has little chance to evaporate. It is exposed to the air above and often some distance below the ground line. Our climate furnishes temperatures that are suitable for fungus growth. There remains only the food supply and this being the post itself, cannot be removed. The only thing left for us to do is to prevent fungus spores from coming in contact with the wood, or to so poison the wood that fungus spores coming in contact with it will not germinate. This is the business of the wood preservative, to form an unbroken antiseptic zone about the wood or at least such a portion of it as is unprotected and would provide suitable soil for the development of fungi.

The simplest form of wood preservative is paint. If the wood is free from fungus and fungus spores, which it rarely is, a coat of paint will keep new spores from reaching the wood and so prevent rot just as long as the coating of paint remains whole and unbroken, but no longer. As soon as the paint film is scratched through or broken in any way, fungus spores can reach the wood and do reach it as we all know, for painted wood does rot, and when decay has once started all the painting we can do will not help it.

Only a little better than painting is the coating of the wood with hot tar. The only advantages that this has over painting are that the heat of the tar when applied may kill any fungus or fungus spores that lie at or near the surface of the wood and being applied hot, a little of the tar will penetrate the outer cells of the wood and so make it a little more difficult to break through the protective coating. When the tar cools, however, it is easily cracked or injured and then decay can start.

Another method of preventing decay has been repeatedly tried and it appeals on account of its simplicity. I refer to charring. It was thought that by subjecting the outer portion of the wood to fire, not only the fungus in it would be killed but that the outer portions of the wood would be partially distilled, leaving preservative materials in the wood. This sounds very plausible but experience has repeatedly shown that not only will charred wood decay very readily, but further, that the substances distilled from wood and known as wood tar and wood tar creosote have very little preservative value even when used in far greater quantities than are produced in charring the wood.

How Decay Can Be Prevented

It appears then, that in order to prevent decay we must in some way poison the outer portions of the wood so that fungi will not grow in it and so that this protective antiseptic zone may not easily be broken. This means that the preservative must enter the wood deep enough so that ordinary wear will not break through and expose untreated wood. It means further that this preservative material must be a permanent nature so that it will remain in the wood after it is put there.

Probably the cheapest and simplest preservatives are metallic salt solutions, such as copper sulphate, mercuric chloride, zinc chloride and sodium fluoride. These are all soluble in water and are applied in water solution. They are injected into the wood under pressure or absorbed by immersion in baths of the preservative. After the treatment the water evaporates, leaving the preservative salts in the wood.

This is all very well for wood that is to be used in comparatively dry situations, but where the wood is to

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Abstract of a paper presented before the New Jersey Highway Association.

be embedded in the ground and will be in contact with earth that is damp for the greater part of the time, they have not proven successful. Under such conditions the process known as leaching takes place, whereby the salts are gradually dissolved in the moisture of the surrounding soil and carried away from the wood so that in a comparatively short time the preservative disappears from the wood leaving it unprotected.

There is, however, a class of preservatives that are only very slightly soluble in water and which at the same time are extremely poisonous to fungi. These are the heavy oils distilled from coal tar and known as dead oil or creosote and green or anthracene oil. Many years of experiment and actual experience have demonstrated the efficacy as the very best means of prolonging the life of wood under all sorts of conditions of exposure.

Now just what are the conditions that a guard-rail post must meet, as far as decay is concerned? First, it is set in the ground so that the lower three feet of it are surrounded by earth. As we know, earth, even in well drained sand, never dries out more than a few inches below the surface, so that the post below the ground line is kept continually moist. The exposed upper part of the post has plenty of air but remains dry. The earth in which the butt of the post is embedded is sufficiently porous to provide an air supply to the post for some distance below the ground line. In clay, this may be only an inch or two, while sand or gravel may be sufficiently porous to allow air to reach the very bottom of the post. Where the posts are shaded by grass and weeds, they frequently remain damp for several inches above the ground line. We see then that just above and below the ground line there is a zone where fungi have just the conditions necessary for their development and that this zone may extend slightly above the ground line and may include the entire lower end of the post.

The Coal Tar Preservatives

The coal tar preservatives of which I have spoken consist of a very complex mixture of chemical compounds. Some of these compounds evaporate readily and consequently do not remain long in the wood, while others are of such high boiling points that they will practically not evaporate at all at ordinary temperatures, or even at the temperatures used during treatment. Here then is the difference between creosote and anthracene oil. Creosote contains a larger proportion of volatile constituents while anthracene oil consists almost entirely of nonvolatile oils that remain permanently in the wood. It would seem then that when creosote is used as a preservative we must anticipate that a large portion of it will disappear when it is exposed to the air. Experiment has proven this to be true and also that the portion that does remain permanently to preserve the wood, consists of the high boiling non-volatile oils, the anthracene oils.

In the preservation of railroad ties, about a gallon of creosote per cubic foot or, roughly, a pound and a half per square foot of lateral surface is found to be necessary to insure proper protection. This is forced into the wood by means of pumps in a tight cylinder. Obviously the entire surface of the wood is treated. In the case of guard-rail posts this is out of the question, because for several reasons the surface of the post above the ground must not be oily. If it were, it would be impossible to paint it white, for the creosote would quickly destroy the color. If it were oily, it would soil the clothing of anyone coming in contact with it. Since it is exposed to the air it is for the most part dry and will not readily rot, so that one-half of the treatment would be wasted.

Methods of Treatment

Our treatment then must be confined to such portions of the post as are exposed to decay. Two methods of application present themselves, brushing and immersion in an open tank of the preservative. Obviously, it is impossible to put a pound and a half of creosote or anything approaching this quantity in every square foot of surface with a brush. With open tanks it is possible but only by means of treatments lasting so long as to make them impracticable. Where any appreciable amount of posts are to be treated this means days or weeks of labor or large tank capacity both for treatment and storage of preservative.

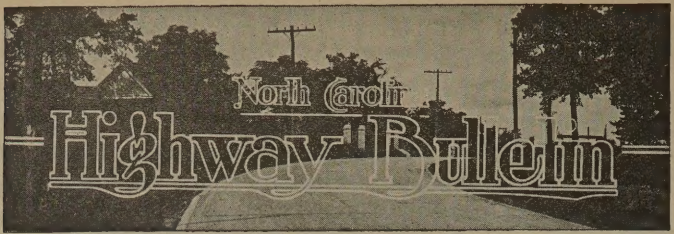
This brings us to the anthracene oils which on account of their nonvolatile nature remain permanently in the wood and which consequently can be used in much smaller quantities to obtain the same results. The higher the specific gravities and boiling points of these oils, the more permanent they are and the less is required for preservation.

Comparable tests of anthracene oils, creosote and other preservatives have invariably shown the superiority of the high boiling permanent oils. Such tests have been performed not only in this country but in France, Austria, Germany and India with always the same result.

For guard-rail posts I would unquestionably recommend what is known as the "hot and cold" double immersion treatment. The apparatus necessary consists of two tanks about 3 ft. in diameter and 4 ft. 6 in. deep. The bottoms of these tanks should be protected from injury by laying a piece of I-beam or rail in the bottom. One of these tanks should be provided with steam coils or be so mounted that a fire may be built beneath it. The other, which is for the cold bath, should be provided with a draining platform on which the treated posts may be stood to allow the surface oil to run off and be returned to the tank. Such tanks as these are readily portable and may even be mounted on a steel truck so that the treating may be done either at the storage yard or on the job.

The process consists in filling the tanks to such a depth, that while the posts are being treated they will be covered to depth of 3 ft. 8 in. The oil in the first tank is heated to about 180 deg. Fahr., and held at this

(Continued on page 7)



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Editorial

Our cover design on this issue shows an attractive piece of paved road in the Third District that has recently been completed. This is typical of the roads that will within a comparatively short time link up North Carolina towns.

The Good Roads Show and Congress which meets in Chicago January 15th-19th, is attracting a great deal of attention from all parts of the country. Inasmuch as North Carolina is one of the leading States in highway construction and maintenance, it is fitting that representatives of the Commission should be on the program. State Highway Commissioner Frank Page will speak on the work that is being done in maintenance in the State while State Highway Engineer Chas. M. Upham will address the Congress on the methods used in constructing the "progressive type" road in this State.

Upon the treatment of guard rail posts depends the length of time that they last and since guard rails are being placed in large numbers on the State Highways the article reprinted in this issue from "Good Roads" should be of interest to every maintenance engineer and patrolman connected with the Commission.

The period of usefulness of any highway depends largely upon the life of the structures spanning the watercourses along the road. Assistant State Highway Engineer C. N. Connor has made a very interesting discussion of this subject on pages 8 and 9.

The Editor would be glad to receive articles on the road work in various districts together with photographs illustrating same. It is obviously impossible for the Editor to get over the State except at rare intervals and in order to keep the people of this and other States posted on what we are doing the co-operation of the engineer in the field is asked.

On the Sabbath so drive your car that when the roll is called on Monday morning you can say, "Glory be, I'm still here."—Akron Motorist.

Making Ready *for the* Road Show

WITH the early start that was made during the summer through a partial reorganization and an election of officers in the American Road Builders' Association and the creation of the Highway Industries Exhibitors' Association to bring about closer co-operation, arrangements are rapidly being made for the Thirteenth American Good Roads Congress and Fourteenth National Good Roads Show to be held in Chicago, January 15, 16, 17, 18 and 19, 1923.

It is the intention to separate the congress and show by holding the former at the Congress Hotel and the latter as usual at the Coliseum. It is believed this arrangement will be more satisfactory as it will obviate the necessity of shutting down the operating machinery during the sessions and will eliminate the noise that has proved so annoying to speakers and delegates at the convention. The new arrangement also is expected to increase the attendance at each session of the congress.

Shortly after his election, Thomas J. Wasser, president of the American Road Builders' Association for 1922-1923, appointed to the executive committee the following: Charles M. Upham, State highway engineer for North Carolina; James H. MacDonald, consulting highway engineer, New Haven, Conn., and J. H. Cranford of the Cranford Paving Company, Washington, D. C. By reason of his position as secretary, E. L. Powers became ex-officio a member of the committee.

This committee, acting for the A. R. B. A., appointed Messrs. Upham and MacDonald, and the Highway Industries Exhibitors' Association designated its president, S. F. Beatty, to act as a committee having general charge of the arrangements for both the show and the congress. The committee is known as the Convention and Show Committee.

This committee has now created several sub-committees to have charge of the various detailed arrangements as follows: Transportation Committee, Royal M. Allen, chairmen; General Publicity Committee, S. T. Henry, chairman; Chicago Press Committee, W. R. Harris, chairman; Exhibitors' Committee, C. R. Ege, chairman; Entertainment Committee, A. C. Cronkrite, chairman; Reception and Hotel Committee, John B. Hittell, chairman; Registration Committee, L. S. Louer, chairman; Banquet Committee, Joseph R. Draney, chairman; Program Committee, E. J. Mehren, chairman.

The Exhibitors' Committee has employed a professional director of exhibits, C. W. Kelley of Chicago, who, though never before identified with the road show, has managed some of the biggest expositions in the country, and the Publicity Committee has re-engaged C. S. Lee of New York, who handled the publicity work for the shows and conventions in 1921 and 1922.

According to Chairman Upham of the Convention and Show Committee, the chief difficulty will be encountered in providing space for all the exhibits, though arrangements will be made for all the additional space it is possible to obtain. "The Highway Industries Exhibitors' Association," said Mr. Upham, "is giving us splendid co-operation in working out the arrangements. We expect to conducct a publicity campaign of greater compelling force and more far-reaching effect than ever before and I believe the attendance will break all records.

"The program for the congress as it is being worked out by the Program Committee, will be the exact reversal of our previous ones. Instead of avoiding controversial subjects as in the past the program next year will be made up almost entirely of controversial subjects of interest to the road-building industry as a whole. This, we believe, will greatly increase the interest in the program and will provoke highly interesting and instructive oral discussions from the floor."

The American Road Builders' Association has opened new offices at 37 West Thirty-ninth Street, New York City, the old ones at 11 Waverly Place having been abolished. Headquarters will also be opened in Chicago long in advance of the congress and show.

THE PROPER TREATMENT OF POSTS FOR GUARD RAILS

(Continued from page 5)

temperature throughout the treatment. The posts should be kept submerged in this bath for twenty minutes, then removed and immediately placed in the second tank containing the cold preservative. They should remain in this tank for ten minutes and finally removed to the draining table where they will in a few minutes become dry enough to handle.

The equipment that I have described is capable of treating ten posts at a time and allowing five minutes for each charge to remove the treated posts and replace them with untreated posts, will treat 180 posts in 8 hours.

So far, I have spoken only of that portion of the post from the ground line down. There are, however, portions of the exposed post where decay is likely to occur. Posts have their tops sawed at an angle and the top rail is fastened so that it rests on this sloping top. Whenever it rains moisture collects in the space between the top rail and the top of the post and is absorbed by the post. This surface being protected by the rail dries out very slowly and consequently the tops of the posts frequently decay. The same is true of the contact surface where the lower rails are nailed to the side of the post or within the holes through which cable is passed. Such contact surfaces and joints should receive protection. Personally I would sacrifice appearance and at least brush-treat all such surfaces. Another way would be to give the entire exposed portion of the post an open tank treatment just as the bottom was treated, using instead of the oil, a solution of sodium fluoride.

Present Tendencies *in* Bridge Design

Paper by LLEWELIN EDWARDS, OF MAINE

Discussion by C. N. CONNOR, OF NORTH CAROLINA

ALTHOUGH in touch with Mr. Edwards at various times I was unable to secure from him a copy or draft of his paper, but after listening to his very valuable talk so well illustrated by pictures, I feel that little can be added.

I believe that the subject is of sufficient interest to you all and that you will pardon any repetitions or duplication of points that may be made.

In the first place it is necessary to realize that the bridge is a very important link in the chain of highway design and construction and as a chain is only as strong as its weakest link, we must certainly build our bridges of sufficient strength and width of roadway to safely and comfortably carry the traffic.

The following points are important in the design as well as the construction of bridges:

1. A complete survey including investigation of foundation material.
2. Design and construction of foundations and footings.
3. Design and construction of substructure.
4. Design and construction of falsework.
5. Design and construction of superstructure.

1. Surveys.—Bridge Engineers are more and more realizing the importance of careful and complete surveys and foundation investigation.

More time spent in the field on this work is one of the best investments that can be made.

I believe that more skew bridges should be constructed and that roadway alignment must not be ruthlessly sacrificed, to obtain square crossings, which in many cases endanger the life of our traveling public.

Much unnecessary money has been spent to pay extra work orders and force accounts, simply because adequate surveys and investigation of foundation material were not made before designs were prepared and contracts let. This is a most important point and one which is being well cared for in the North Carolina specifications.

The tendency on this particular point should be to anticipate every possible foundation condition in order to have our contractors bid intelligently rather than on an uncertainty.

2. Design and Construction of Foundations and Footings.—This undoubtedly is the most important part of a structure. Foundations should never be sacrificed by "skimpy" or "skinny" design. By them the entire structure is supported; they must resist scour, unprecedented floods, deterioration, sometimes poor and unintelligent inspection, sometimes an unscrupulous contractor; if they fail, the cost of replacement is always excessive and it can seldom be done in a wholly satisfactory or acceptable manner.

The tendency in design of this portion of a structure should be only in one direction and that is 200 per cent safe.

3. The Substructure.—I think that too many designs have been put out in recent years which show the skill of the designer in avoiding good old substantial concrete. and substituting therefore a large amount of reinforcing steel.

Please don't misunderstand me, I believe in reinforced concrete and economical design, but when we are dealing with such uncertainties as the theory of earth pressure, the Engineering News formula per pile pressure, breaking down of concrete exposed to sea water or even sea breezes, the swelling of steel when not properly protected against corrosion and unexpected construction joints, we must be conservative in our substructure designs.

To my mind the proportion of 1:3:6 is not a mix of concrete and should seldom, if ever, be used in any portion of a bridge; it is too lean.

Why should we put miles and miles of 1:1½:3, 1:2:3, and 1:2:4 concrete, costing millions, into our roads and then try to save a few paltry dollars on a lean mix of concrete in one of the most vital portions of highway construction, the bridge?

4. Design and Construction of Falsework.—There are probably more ways and methods of building falsework and form work than of designing bridges. They have not been standardized, specifications are not sufficiently definite; we say forms shall be water tight, that so and so shall be to the satisfaction of the engineer, or as the engineer may direct, but the judgment of engineers may differ. For roadway work we say steel forms shall weigh not less than nine pounds per foot and we are much more definite generally.

Gentlemen, we must be definite in our State Highway Bridge Specifications, especially in the matter of falsework and forms.

Let's put our falsework on piling whenever and wherever we can, let's cut out the mud sill, let's give a minimum thickness of form lumber, a limiting size and spacing of joists, studding and walers.

The appearance and oftentimes the actual strength of a well designed structure has been ruined by poor falsework or forms.

It is just as important to have good foundation material under the falsework as under the finished piece or abutment itself.

5. Superstructure.—By far the greater portion of bridge superstructures are under 40 feet in span and are of reinforced concrete. Into these shorter span structures most of our bridge money is going and it is here that our study and attention should first be directed.

Present day tendencies are undoubtedly toward reinforced concrete slab, or slab and girder design. The arch and cantilever arch are also receiving some consideration in these shorter spans.

The only impressions gained of a bridge by the traveling public are those attained by the appearance of the superstructure, the riding qualities of the bridge floor and the clearance that must be allowed in passing another car. There have been comparatively few failures of bridge superstructures except in cases where the substructures were at fault.

Possibly our superstructures are too strong; at any rate I believe the distribution of moving loads will still bear investigation.

Many arches, especially those with a small rise, are carrying as much steel for temperature and axial stresses as they do for dead and live load. Is this all right? According to theory, yes; according to actual conditions, what?

Just one word in regard to hand rails and expansion joints. Many a hand rail has been ruined by poorly designed or poorly constructed expansion joints, which spall or crack at the first change in temperature, moisture or settlement.

The joint must be simple or poor construction may result. I would like to propose for your consideration an open joint with no filler as the most satisfactory.

The bridge floor must be smooth, with no humps or hollows at the approach ends.

Timber trestles should have solid floors with a back top to take up vibration and furnish good riding qualities.

Clearance between curbs must be sufficient, generally not less than 20 feet.

You have probably observed that clearance appears to be less when driving on a bridge than when driving on a pavement. This is especially true on deep thru girder bridges.

Just one word on bridge standards and to quote Mr. Charles Meade who says, ''This work can easily be over-systematized. It is possible to standardize certain structural parts of a bridge such as docks, abutments, walls, floors and railings........ It is not practical to standardize the assembly of those parts, because it is very rare to find two physiographic locations where exactly the same structure will fit—hence the term 'standard' as applied to complete bridges is a misnomer.''

I believe we should also be especially cautious in standardizing substructures.

In order to get the best designs and the best construction it is absolutely necessary to have your designers get out in the field and learn how the bridge is built; his designs will be more simple.

Your construction man must visit the office and study the plans and if possible do some designing. Then your construction work will improve, your steel will be put in the right place and fewer extra work orders will appear.

In closing may I again call your attention to these salient points:

1. Make your surveys and investigations thorough and adequate.
2. Don't skimp on foundations or substructure.
3. Give your contractor definite requirements, especially on his forms and falsework. What does he care for 16,000 pounds per square inch in steel, or 650 in concrete?
4. Make your floors smooth, roadways of sufficient width, and last but not least, build a simple but efficient expansion joint in the hand rails.

The general public which pays for roads and bridges will sometimes countenance cracks in concrete roads, humps in black top, holes in macadam, boulders in gravel, mud on dirt roads, but when a bridge fails, he calls down the wrath of the gods.

I AM THE MOTOR

I have clipped the wings of Time; and broken through the barriers of Space.

I have opened the gates of the cities, that those who dwell therein may go as on wings to the open spaces, and find again the sun and the wind and the stars they had forgot; and watch the passing pageant of the seasons—spring mornings that burn with a green flame in the meadows, and summer nights beneath the cool arch of the silent stars, and autumn afternoons, with a dying glory on hill and sky.

In the busy marts by day, your ear has heard my whirring in a thousand streets. Because of my presence the wheels of industry spin faster; the work of the world is done in shorter hours.

Through the stretches of the night you have listened to my rumble over the long dark roads, bearing the barter of city with city—the machine that is needed in a hurry, the repair part that is holding up the work of a hundred men; the daily food supply of millions. Over a thousand long roads I rumble on.

I have given much; and one thing have I asked—**roads.** Flowing roads for my spinning wheels; roads to reach into the humble corners, and stretch even to the far places of the earth. So that I may go safely and with speed, and bring my gifts every where, and to all.

—F. F. R.

LOCATING AND MAPPING HIGHWAYS IN NORTH CAROLINA

(Continued from page 3)

ter alignment, grades, and drainage have been secured. In the final analysis savings in maintenance and operating costs may well be anticipated from a scientific, economic location.

Location Procedure

The procedure in making surveys is similar to that in railway location—first, the reconnaissance, followed by one or more preliminary lines with topography, and contours when necessary; then the projection or paper location, and lastly the final location. All P.C's and P.T.'s are carefully referenced by the locating parties, and all field notes are required to be kept in strict accordance with prescribed forms. Careful preliminary cross-sections are taken over the located line at every station and at every important break in the ground. These are merely transverse profiles and are taken by recording the vertical height of each break in the ground at right angles to the center line above or below the ground at right angles to the center line above or below the ground at the center stake, and the horizontal distance therefrom.

When the survey is finally completed the chief of the party plats the profile in pencil on standard sheets 36 x 23 in. to a horizontal scale of one inch to one hundred feet and a vertical scale of one inch to ten feet. On this he lays tentative grade lines representing the subgrade, and he also shows the classification of the materials encountered.

The note books show the suggested size and type of drainage openings required, as determined by special surveys, and other complete information necessary for the proper preparation of plans and estimates. The profile and all of the note books are then sent to the principal locating engineer at Raleigh where they are carefully inspected and then turned over to the drafting department where the final plans are prepared. The alignment, topography, and all other features are platted above the profile to a scale of 100 ft. to the inch.

The preliminary cross-sections are platted on standard-size (36 x 23 in.) sheets and the quantities are computed from planimetered areas of the same. The quantities are then properly balanced by the readjustment of the tentative grade lines. Prints are then made of the project and sent to the District Engineer, who walks over the line, plans in hand, and carefully studies the grades, drainage openings and other features of the survey. He makes such corrections or changes as may seem proper and returns the prints with his approval. The plans and estimate are then completed, the necessary number of blue prints made, and the project is ready to advertise for construction.

A set of prints of a given project consists first of a title sheet, showing the title; index of sheets; a small map of the entire project on a scale of one inch to 1,000 ft.; a small inset map of North Carolina showing the general position of the project with reference to the State as a whole, and a small inset map showing the position of the project with reference to the county and to existing railway and other shipping points.

The next sheet shows the typical cross-section of the roadway, the design of the pavement or surface, ditches, etc.

Then follow the plan-profile sheets showing alignment, grades, clearing, drainage structures, balance points, summary of quantities and other information of interest to a contractor. Next come the cross-section sheets, showing accurate areas and yardages. Then comes a sheet showing the type and design of headwalls, retaining walls or special drawings, and finally come the sheets showing designs in detail of all bridges and culverts, which are prepared in the office of the bridge engineer from special surveys made under his direction.. A complete set of plans consists of from 25 to 200 prints bound together.

Costs

The total average cost per mile for making a finished location, as before mentioned, is $92 and the average cost of preparing completed plans and estimates, exclusive of bridge and culvert designs is $25.53 per mile, making a total average cost per mile of completed location, plans and estimates of $117.53 for the entire State. These figures are remarkably low considering the large amount of work involved and the care with which it is performed.

It should be borne in mind that western North Carolina has some of the most rugged mountain country east of the Mississippi and that the eastern section contains many large rivers and almost impenetrable swamps which naturally make for difficult and costly location.

The writer feels that the satisfactory results now being obtained with regard to highway location are due entirely to the highly organized and centralized departments of the State Highway Commission and that without such centralized organization the task of locating and building 5,000 miles of new highways would be many times more difficult and costly.

Selecting *the* Federal Aid System

THE selection of the roads which will compose the system of Federal Aid highways which will reach into practically every county of the United States is progressing rapidly according to the Bureau of Public Roads. State and Federal engineers have held numerous conferences during the past summer in all sections of the country. The system is being outlined in accordance with the requirements of the Federal Highway Act of last November which contemplates a system of highways to be built with Federal Aid such as no other nation has ever possessed and which, once built, will be continuously maintained in serviceable condition. Eighteen feet will be the minimum width of roadway unless conditions justify a lesser width and such cases must be given special approval. The system will consist of not more than 7 per cent of the total road mileage in any one State, not more than 3/7 of which will be primary or interstate highways and the remainder secondary or inter-county highways. The total mileage of primary and secondary roads will be approximately 187,000 miles.

Work has progressed rapidly on the system during the past year and 10,000 miles of road have been completed in conjunction with Federal Aid. These have been projects of such importance that there is no doubt as to their being included in the system as finally outlined.

The following table gives the approximate mileage of the primary and secondary system in the various States. In 13 States the figures are based on the total mileage of highways in the State, while the remainder are based on maps submitted.

	Mileage in Primary System	*Mileage in Secondary System*	*Total Federal Aid System*
Alabama	1,696	2,262	3,958
Arizona	642	856	1,498
Arkansas	2,158	2,879	5,037
California	2,015	2,432	4,447
Colorado	1,440	1,920	3,360
Connecticut	350	470	820
Delaware	115	151	266
Florida	1,127	833	2,960
Georgia	2,427	3,235	5,662
Idaho	1,163	1,609	2,772
Illinois	2,888	3,851	6,739
Indiana	2,128	2,838	4,966
Iowa	2,930	4,214	7,144
Kansas	3,216	3,384	6,600
Kentucky	1,370	1,880	3,250
Louisiana	1,200	1,600	2,800
Maine	492	834	1,326
Maryland	444	592	1,036
Massachusetts	533	737	1,290
Michigan	2,250	3,000	5,250
Minnesota	3,091	4,122	7,213
Mississippi	1,416	1,874	3,290
Missouri	2,345	4,461	7,806
Montana	2,000	2,700	4,700
Nebraska	2,408	3,211	5,619
Nevada	600	920	1,520
New Hampshire	293	707	1,000
New Jersey	513	685	1,198
New Mexico	1,390	1,867	3,257
New York	2,150	2,404	4,554
North Carolina	1,840	2,354	4,194
North Dakota	2,061	2,754	4,815
Ohio	1,690	2,315	4,005
Oklahoma	3,381	4,508	7,889
Oregon	1,177	1,628	2,805
Pennsylvania	2,700	3,600	6,300
Rhode Island	79	86	165
South Carolina	1,371	1,854	3,225
South Dakota	3,462	4,615	8,077
Tennessee	1,329	2,748	4,077
Texas	3,640	8,015	11,655
Utah	690	965	1,655
Vermont	444	599	1,043
Virginia	1,600	2,133	3,733
Washington	1,273	1,697	2,970
West Virginia	942	768	1,710
Wisconsin	2,364	3,152	5,516
Wyoming	1,288	1,946	3,234
Totals	71,492	98,079	187,406

From the present outlook it is thought that this program of road construction will cover a period of from 15 to 20 years. Many States will complete their mileage in a much shorter time as they have included in the system a considerable mileage of improved road. They will then enlarge the Federal Aid system by including additional mileage. When the system is complete the total improved mileage of the country will be far greater than the 187,000 miles included in the system. How much greater, it is hard to say, but in all of the States the system has been outlined, keeping in mind that State roads independent of Federal Aid will connect with it.

GOOD ROADS HAVE ONE DRAWBACK

It's nice to live in the country—nice for your city relatives when the auto season gets in full swing. It's pretty hard for a country cousin to get out of reach of the auto.

IT'S A REAL RARA AVIS ALL RIGHT

A prospective buyer walked into the garage and said to the proprietor: "I would like to see a first-class second-hand car."

The proprietor looked at him, and smiled as he replied: "So would I, brother."—Jack-O-Lantern.

National Road Building *by a* Vast Increase *in* Motor Transport

By BEN. M. McKELWAY, "*Trained Men*"

INDUSTRIAL America, outstripping in its rapid development the railroad facilities of the country, has found that the answer to a serious question of transportation lies in the motor vehicle. Last year it carried six times as many passengers, and 87 per cent as much freight as all the railways of the United States combined.

But in the solution of one problem, another and a graver one has been created. The railroad first builds its roadbed and then adds its rolling stock. In highway transport, the American public finds itself today in possession of more than 10,000,000 motor vehicles, representing an investment nearly four times greater than the amount spent in the last 10 years to provide a roadbed for that rolling stock. In the last 11 years the increase in motor registration has been 1,800 per cent, but the effective expenditures for road building for a corresponding period show only a 400 per cent increase.

There is but one answer to this second problem—there must be a National Program for Building Highways. One is already in a fair way of being established through what has become a fixed policy for Federal aid to States. It involves the expenditure of billions of dollars for the construction of thousands of miles of good highways, and for the employment of trained men over a long period years. Out of it has come the Roosevelt National Highway, with its 3,368 miles from the Nation's Capital to Los Angeles; the Lincoln Highway, extending 3,323 miles from New York to San Francisco; the Dixie Highway, 2,308 miles from Calais, Maine, to Florida's favorite Miami; the George Washington, from Savannah to Seattle; the Mississippi Valley, the Pacific, the King of Trails, from Canada to Texas—all of these but the beginning of a plan to lace America together with ribbons of brick, asphalt, and concrete.

Systematic road building in this country is newer than motor transportation. Expenditures from 1900 to 1910 were negligible, but since then the States, with Federal aid, have invested approximately $2,526,000,000 in their highways. In 1910 the automobile industry was just getting on its feet; that same year saw the first boom in road building, the States expending about $120,000,000. Two years later the Government began its financial participation, appropriating $2,000,000. The following table, strikingly showing the increases from year to year since 1917, includes Federal funds:

Year	Expenditure
1904	$ 59,527,170
1914	240,263,784
1917	279,915,332
1918	286,101,198
1919	383,455,932
1920	500,000,000
1921	767,000,000
1922 (estimated)	772,000,000

"The utility of the motor vehicle to a large extent is dependent upon the improved highway," says Thomas H. MacDonald, Chief of the Bureau of Public Roads of the Department of Agriculture. Mr. MacDonald has been called "the greatest spender in the country." Through his hands pass the millions appropriated by Congress for distribution among the States.

To illustrate that the vehicle and the highway are one and the same problem, he tells a story which might be labeled, "The Penny and the Cream for the Oatmeal."

"We have a coin of the realm, known as a copper cent, which is not greatly respected," he says.

"Our milkman drives a rather large truck. As I come down the stairs in the morning, I see that he has deposited on the front porch our daily portion of milk. Now I am particularly fond of what comes on top of that milk, and do not consider a day well begun unless I have oatmeal and cream.

"I figure that to me, as an average American citizen, the cost of the highway in transporting that milk, which I consider essential to my well being, is this little-respected penny, and the highway cost of all the rest of my food which is transported over the roads is nothing at all!

"That was the cost of the American highways to the individual man, woman, and child in this country last year, after deducting the exact revenue which the automobiles contributed in fees to the road built. The amount deducted does not include any of the intangible income from motor vehicles. Perhaps I am not exactly accurate; the cost may be about one and one-tenth cents, as near as we can estimate it. It does seem, therefore, that we can afford the highways.

"I have contemplated the poorest child in the poorest tenement district in New York City, wondering if we could decrease to him the bill of our American highways. Can we consider that to him—or to any one—the tangible personal benefit from our American highways is worth at least one copper cent per day for the transportation of food he eats."

Efficient transportation is necessary for the nation's existence. And the advent of motor transportation has put it, with the railroads and with the waterways, as a necessity. The problem concerns all, for all use the highways. To quote President Harding in his first message to Congress: "The motor vehicle has become an indispensable instrument in our political, social, and industrial life."

Have you ever thought just how indispensable an instrument the motor car really is?

Last year, according to figures compiled by the National Automobile Chamber of Commerce, the motor car carried 6,990,862,000 Americans over an area aggregating 70,820,000,000 miles. Motor trucks at the same time were carrying 1,430,000,000 tons of freight of every conceivable description over 6,479,200,000 miles. Three million automobiles and trucks are found today on the farms of the country. One hundred thousand doctors rely on the motor car to carry them back and forth on their errands of mercy. Last year something like 50,000 school children were transported in motor busses, while 135,000 suburbanites were chiefly dependent on their cars to take them to and from their daily work.

Within the last 20 years farmers have gone further into the remote rural sections, their motor trucks establishing a connecting link between food production and the point of marketing. Records of the Department of Agriculture indicate that in many cases the farmer's haul to market has been increased from 6.9 to 17.6 miles, an expansion based entirely on motor-truck haulage.

The city man has gone far into the suburbs to escape the baneful effect of living in offensive, in many cases unhealthy, contact with factories. Conditions in any city show its central portions are being driven more and more to commerce and manufacturing, and that the residential section constantly moves further and further into the suburbs.

So much for some of the accomplishments of motor transportation in a half score of years. But what of the future? Mr. MacDonald says the utility of motor transportation is dependent upon the improved highway. What must we do to expand this utility?

"It is possible," Mr. MacDonald points out, "to comprehend something of the physical and financial undertaking involved in the completion of a great building or a great bridge, because each may be within the range of vision. But who can adequately picture to himself the immensity of the highway improvement demands now being made within the United States, to say nothing of those of our territorial possessions? No other nation has ever undertaken to supply adequate transportation facilities to an area of over 3,000,000 square miles. France has an area of 212,654 square miles, Germany, 208,780, while the borders of Texas alone enclose 262,398 square miles. Our States are empires in their extent, and the whole future of this nation will be largely modified and determined by the factor of transportation, including in this sense, all forms of interchange, as we toady have them and know them. There are no precedents from which we may accurately estimate the total cost of providing necessary improved highways, but the financial aspects are even now so large as to demand the most careful and scientific policies which may be determined. As the costs accumulate from year to year, the increasing demands upon the financial foundation will cause failure, unless Government policies are properly determined and planned for the future.

"No reason can be offered for not planning well for the future, for we are yet near the beginning of highway building activity in its major sense. There are not the same uncertainties that confronted the railroad builders. The early railroads were built largely on the strength of prospective and to an extent problematic traffic. The highways are being built for a traffic already waiting.

"There are plenty of evidences that the taxpaying public is rapidly nearing the end of its ability, or at least of its willingness, to act further in the capacity of a shock absorber. Too many public enterprises have been saved from bankruptcy only by calling on the public treasuries for additional funds to wipe out the deficit between estimate and cost, between income and outgo. There is no reason why the highways should not be placed in the self-supporting class. They are not a luxury nor an incidental, but one of the indispensable facilities to all phases of the life of the nation and of the individual. The highways are possessed of a real earning capacity, and this must be recognized, collected, and credited to them."

The present Highway Building Program, entertained by the Bureau of Public Roads, contemplates 180,000 miles of roadway, of which funds for the construction of about 71,000 miles, or nearly 40 per cent of the total, have been made available. No time has been set for the ultimate realization of this national program.

If the Federal Government is willing to spend $50,000,000 a year, it may take 20 years. If Uncle Sam can spare $75,000,000 from the Federal treasury each year—assuming the States will pay 58 per cent of the total road-building cost—the job can be completed in 15 years. If the United States Government is willing to spare $100,000,000 a year, assuming the States bear their proportionate cost, the work can be done in 10 years.

The Highway Building Program contemplates a national system of roads. Motor transportation has made this a necessity. The time has passed when the Federal Government will appropriate funds for the States to spend as they please in improving and building their own inter-county or town-to-town systems. We have passed the stage when one community can be considered, and reached the point where the country as a whole must come within the program.

When the 180,000 to 190,000 miles of road contemplated are completed, they will connect practically every county seat in every State, and will also connect at State borders with those from other States. Eventually, it should be possible to drive from any county seat in one part of the country to another like point in any other part of the nation without leaving a Federal-aid highway.

Apparently Federal aid to the States has become a fixed national policy, for on June 19, last, President Harding signed the Post Office Appropriation bill, authorizing an additional fund of $190,000,000 for that purpose—$50,000,000 being authorized for the present fiscal year which began June 1st; $65,000,000 and $75,000,000 respectively, for each of the two succeeding fiscal years. It is estimated that this $190,000,000 will result in the construction of more than 25,000 miles, which, added to the 46,000 miles expected to result from previous appropriations, makes a total of 71,000 miles, or nearly 40 per cent of the estimated 180,000 miles of road in the Federal aid system now being outlined. To match the $287,500,000 of Federal funds involved, the States have appropriated $380,000,000, making a grand total of $667,500,000.

There is, perhaps, no wider field for specialized employment in industrial America today than that which has been opened by the impetus given to highway construction. It has been reflected so far in the amount of attention being given by Federal and State highway commissions to increasing and improving their personnel. The volume and character of motor-driven traffic today has rendered obsolete much of the so-called science of road building. Only recently has any attention been given to the impostance of highway transport in its relation to highway engineering and highway economics.

The problem created by the lack of trained men to carry out the vast road-building program of the future, and to adapt it to the new science of highway transport, has brought about the formation of the Highway Education Board, which was created to recommend courses in highway engineering and highway transport, and to undertake researches into the problems presented in highway engineering and transport.

For the year 1921-22, this committee learned by a recent survey, that 8,709 students were listed in 114 schools as preparing for civil engineering. Of 1,870 who were members of the senior class, more than one-fourth, or 503, had indicated a desire to specialize in highway engineering. Only 48 out of the 114 schools reporting permitted or indicated special courses in highway engineering.

Suppose, by a generous estimate, we double the number of seniors last year who actually testified to their desire to specialize in highway engineering. There would be around 1,000. A pitiful small supply to meet an ever growing demand!

Lewis W. McIntyre, Assistant Professor of Civil Engineering of the University of Pittsburgh, and a member of the Society for the Promotion of Engineering Education, calculated recently that there is already a demand for 9,600 men with engineering training employed by highway bodies in the United States outside of county and municipal organizations. Of this number 10 per cent are needed as replacements each year.

In addition to technical knowledge the highway engineer must know the fundamentals of practical road building. He must have a fundamental knowledge of the motor vehicle, and a fundamental knowledge of methods of highway transport. His field is virtually unlimited.

The highway transport engineer must solve the problems of the future in motor transport, must anticipate the trend and direction of city and suburban traffic, must know how to relieve congestion resulting from the steady increase in rolling stock. He must know the limitations of the motor vehicle, be familiar with its mechanical upkeep, its operating economics, and its adaptability. He must solve the problems of the community or the group of shippers employing him and be able to tell what roads should be improved. He must select the best routes, the best equipment, and he must reduce the operating costs for owners of motor truck fleets.

P & H Eliminates Coffer-Dams

Knowles & Fehr, Chicago contractors, are digging a six foot trench across the Milwaukee River with a P & H 206 Dragline-without the building of coffer-dams.

Over the rough, rock-strewn river bed, the sure-footed P & H Corduroy Traction carries the Dragline, the excavation of boulders and hand pan demonstrating the reserve power of the P &H heavy duty gasoline engine.

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P&H EXCAVATORS

The rapid growth of the motor industry has far outrun the number of available trained men, and the future of this, now the second largest industry in the country producing the finished article, is limited only by the actual production of motor vehicles and the construction of good roads.

The time will come when the one road cannot serve the speeding passenger car and the lumbering motor truck. Separate roads must be built between congested centers to serve both needs. Our cities, built with their short corners and crooked streets to serve the slow, horse-drawn traffic of another era, must eliminate their rapidly increasing street congestion by the construction of private rights of way, improved terminal facilities for fleets of trucks, and by the designation of heavy and light traffic streets.

The men to bring about this great development are here. As the pioneers of a generation or two ago, who with grim and unhesitating valor packed their belongings into covered wagons and took their families with rifle and dog, out into the open, they are ready to pioneer a new age. But to their number must be added others who must be summoned to this pioneering of a new industry, and must be trained for this tremendous, noble calling.

For "the cause of the highways is everybody's business, because it is everybody's benefit."

STATUS OF FEDERAL AID WORK IN NORTH CAROLINA

Projects Under Construction

"H S" denotes any type of hard surfaced road.

"G" denotes any type of gravel, sand-clay, or topsoil road.

NO	COUNTY	LENGTH	TYPE	APPROXIMATE COST	BEGUN	CONTRACTOR
15	Guilford	4.205	H S	$ 5,441.75	9–1–17	County Commissioners.
17	Wilkes	17.6	G	101,386.08	10–15–18	County Commissioners.
61	New Hanover	2.186	G	234,841.39	7–12–20	C. W. Lacy
69	Transylvania	9.348	G	231,409.04	3–25–20	Allport & Alexander Construction Co.
75	Columbus	7.06	G	66,605.38	12–9–20	County Commissioners.
94A	Mitchell	5.04	H S	190,375.13	6–22–20	Gibson Construction Co.
125A	Alleghany	4.99	G	153,899.13	11–22–21	W. E. Graham
127	Wilson	7.63	G	33,780.45	3–5–21	County Commissioners—Lee J. Smith.

Projects Completed

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	COMPLETED	CONTRACTOR
1*	Mecklenburg	....	Bridge	$ 59,224.90	9—5–18	C. W. Requarth & Co.
2*	Henderson	7.75	G	33,141.74	12–17–19	State Convict Labor
3*	McDowell	2.85	G	24,405.73	12–17–19	County Commissioners
4	Craven	9.46	G	21,089.23	10–12–19	County Commissioners
5*	Burke	8.03	G	19,888.05	11—1–19	County Commissioners
8*	Cumberland	13.46	G	62,800.71	6–20–21	County Commissioners.
9*	Polk	12.78	G	68,175.45	4–15–21	County Commissioners.
11*	Lenoir	1.78	H S	56,893.18	1–25–21	West Construction Co.
12*	Wayne	8.62	G	26,727.98	11—2–20	County Commissioners.
13*	Wayne.	12.573	G	101,467.23	12—1–21	County Commissioners.
14*	Halifax	8.01	G	19,017.83	8–20–20	State Convict Labor.
16	Haywood	14.27	G	64,705.05	9–22–22	County Commissioners.
18*	Alexander	9.8	G	66,446.49	3–31–21	County Commissioners.
19*	Rockingham	8.21	G	32,759.36	11–11–19	County Commissioners.
20*	Yadkin	6.41	G	25,146.45	7–26–20	County Commissioners.
21*	Person	7.675	G	25,911.04	3–15–20	County Commissioners.
22A*	Alamance	1.196	H S	30,103.48	6–27–19	County Commissioners.
22B*	Alamance	8.3	H S	290,179.36	8–19–21	Powell Paving and Construction Co.
23*	Burke	68	G	42,873.90	11—1–20	Lovelady Township Forces.
24*	Wake	4.24	H S	127,840.21	11–30–19	W. W. Boxley & Co.
25*	Person	8.175	G	101,537.51	10–20–20	County Commissioners.
26*	Davidson	8.41	G	14,115.96	10—1–19	County Commissioners.
27A*	Orange	8.235	G	53,945.73	4–23–21	W. S. & L. A. Crawford.
29*	Union	8.655	G	58,949.25	4—8–21	County Commissioner—J. S. Stearns.
30*	Mecklenburg	6.304	H S	102,551.35	3–31–21	County Commissioners.
31*	Buncombe	3.1	H S	70,147.88	10–24–19	County Commissioners.
33	Montgomery	3.72	G	15,246.71	7—8–21	County Commissioners.
34	Wayne	....	Bridge	50,798.00	10—8–21	Roanoke Bridge and Iron Works, Inc.
35*	Forsyth	1.87	H S	59,867.61	2–25–20	Counry Commissioners.
36*	Durham	3.46	H S	115,075.57	12–15–19	R. G. Lassiter & Co.
37*	Gaston	10.30	H S	167,173.23	12–28–21	County Commissioners.
38*	Rockingham	10.92	G	46,809.92	9–17–20	County Commissioners.
38A	Caswell	6.67	G	50,907.23	7—6–21	Bolton Construction Co.
39*	Union	10.61	G	74,337.71	4—9–21	County Commissioners—J. S. Stearns.
40*	Union	4.287	G	18,434.20	12–11–20	County Commissioners.
41	Watauga	8.95	G	94,681.29	11–10–21	County Commissioners.
42*	Stanly	11.67	G	80,922.15	9–10–20	Gibson Construction Co.
43*	Beaufort	2.2	H S	95,089.12	5–11–20	Simmons Construction Co.
44*	Granville	4.57	G	51,377.43	4–20–21	T. W. Chandler—P. R. Ashby.
45*	Buncombe	7.852	H S	359,777.28	7–23–21	H. A. Wells—Asheville Construction Co.—Asheville Paving Co.
47*	Guilford	4.607	H S	162,689.83	4—8–21	County Commissioners.
48A*	Northampton	5.804	G	60,620.51	10–30–20	Virginia Contracting Co.
48B	Northampton	2.69	G	44,749.65	10—4–20	Porter & Peck—A. C. House.
49*	Lenoir	6.017	H S	199,872.19	6—1–21	T. H. Gill & Co.—West Constuction Co.
50*	Guilford	2.65	H S	101,596.44	12–31–20	County Commissioners.
51*	Guilford	2.26	H S	87,603.12	9–27 20	County Commissioners
52*	Cabarrus	8.986	G	162,399.61	3–22–21	Gibson Construction Co.—J. E. Lane.
53*	Lenoir	7.234	H S	246,838.20	2–10–21	T. H. Gill & Co.—West Construction Co.
54*	Wake	6.811	H S	239,736.26	8–23–20	R. G. Lassiter & Co.
55A*	Mecklenburg	6.008	H S	196,899.73	12–28–20	Simmons Construction Co., Inc.
55B*	Mecklenburg	4.59	H S	188,445.18	8–13–21	Simmons Construction Co., Inc.
56*	Forsyth	5.868	G	47,709.31	10–29–20	C. B. Hester—Luten Bridge Co.
57	Rowan	6.75	G	72,549.27	4–22–21	W. E. Graham—R. M. Hudson Co.
58	Johnston	6.018	G	69,453.50	5–20–20	P. R. Ashby.
59	Columbus	11.025	G	106,872.26	1–26–22	County Commissioners.
60	Lenoir	7.88	H S	259,445.25	3–31–22	T. H. Gill & Co.—West Construction Co.
62	Buncombe	3.43	H S	139,191.32	1–27–22	H. C. McCrary, Inc.—Asheville Construction Co.
63*	Buncombe	3.76	H S	167,933.55	9–20–21	Allport & Alexander Construction Co. —H. C. McCrary, Inc.—Asheville Paving Co.
65	Pitt	9.57	G	99,191.06	10–20–21	Porter & Peck.

STATUS OF FEDERAL AID WORK IN NORTH CAROLINA---*Continued.*

Projects Completed (Continued.)

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	COMPLETED	CONTRACTOR
66	Haywood	6.18	G	$ 105,296.45	4–4–22	O'Biern Construction Co.
67*	Nash	8.81	H S	384,126.08	4–20–21	R. G. Lassiter & Co.
68	Sampson-Harnett	27.4	G	305,225.54	6–24–22	P. R. Ashby—F. L. Grant, Inc.
70A	Jackson	4.83	G	150,081.11	8–18–20	Wright & Nave.
71	Durham	6.69	H S	319,153.39	10–26–21	State Forces.
72*	Anson	3.896	G	70,470.89	3—4–21	Gibson Construction Co.—J. A. Kreis & Co.
73*	Nash	8.73	G	159,913.16	4–10–22	Porter & Boyd.
74A*	Stanly	2.803	G	25,537.45	8–20–20	County Commissioners.
74B	Stanly	4.92	G	63,411.26	5– –21	County Commissioners.
76*	Cabarrus	1.35	H S	54,583.76	10–29–20	R. M. Hudson & Co.
77*	Rutherford	2.206	H S	100,159.44	9—5–21	E. T. Belote.
78A*	Rutherford	9.64	G	88,230.71	8—3–21	Ross Brothers.
78B*	Rutherford	10.26	G	71,056.48	8—3–21	Ralph E. Oliver.
79*	Cleveland	1.645	H S	67,063.64	10–30–20	Noll Construction Co.
80A*	Montgomery	16.6	G	226,516.20	6–20–21	County Commissioners.
80B*	Montgomery	11.07	G	65,145.02	10–25–21	Lee J. Smith Const. Co.—P. R. Ashby.
81	Pender	26.11	G	273,439.45	12– –21	Porter & Boyd.
82	Davidson	4.54	G	59,983.71	12–18–20	Heilig & Sherrill.
84A	Burke-McDowell	8.33	G	128,193.76	8—3–21	J. A. Kreis & Co.
84B*	McDowell	6.76	G	109,659.49	8—1–21	J. A. Kreis & Co.
85*	Davie	8.28	G	58,756.89	9–26–20	W. E. Graham.
86A	Martin-Bertie	3.09	G	98,454.67	2–25–20	State Forces.
86B	Martin-Bertie	....	Bridges	332,308.83	3–19–21	Boyle-Robertson Construction Co.
90*	Pamlico	12.03	G	127,981.78	9–16–21	Eagle Engineering Co.
91*	Surry	10.68	G	113,805.84	6–27–21	W. E. Graham—R. W. Curtis & Co.
92*	Surry	10.38	G	133,141.03	6–20–21	W. E. Graham—R. W. Curtis & Co.
93	Franklin-Warren	19.8	G	192,993.57	9–25–20	Chandler & Ragland—Stearns Bros.
96	Yancey	2.95	G	82,653.12	1–10–22	Gibson Construction Co.
98A	Moore	20.53	G	259,240.38	5–31–22	J. T. Plott—J. E. Lane & Co.
98B	Moore	8.75	G	41.055.46	3—8–22	Lee J. Smith Construction Co.
98C	Lee	4.53	G	18,240.64	10–29–21	Gibson Construction Co.
99A	Chatham	12.65	G	126,717.70	8–11–21	T. W. Chandler and State Forces.
99B	Chatham	21.82	G	259,931.59	11–19–20	J.T. Plott—Atlantic Bridge Co.
100	Avery	14.00	H S	272,089.78	3–20–22	Southern Dray Co.
101A*	Randolph	10.14	G	123,893.99	8–12–21	S. L. Davis—J. A. Kreis & Co.
101B	Randolph	9.64	G	107,928.75	3—6–22	J. T. Plott—Hanford Bros.
103*	Duplin	11.32	G	111,931.05	10–20–21	County Commissioners.
105*	Hoke	9.8	G	95,501.80	10–25–21	Jameson Brothers—George, Hankins & George.
107	Madison	2.46	G	70,901.40	10–11–21	Southern Dray Co.
109*	Burke	3.58	G	55,191.64	5–21–21	C. E. Teague.
111*	Forsyth	12.22	G	94,447.10	8–17–21	C. B. Hester—Heilig & Sherrill.
112	Caswell	11.93	G	147,065.71	11—2–21	J. M. Gregory and J. E. Lane & Co.
114*	Rowan	2.543	H S	83,587.02	3–17–21	R. M. Hudson & Co.
116*	Stanly-Montgom'	....	Bridge	199,614.80	1—9–22	Cornell-Young Co.
117	Wilson	6.25	G	41,828.93	3–21–22	County Commissioners—Lee J. Smith.
120	Bladen	23.67	G	105,688.55	4–18–22	J. A. Morrow—P. A. Ashby.
121*	Stokes	11.60	G	108,519.62	1–14–22	Jameson Bros.—Rogers & Shumway.
129	Richmond	17.28	G	77,507.48	12–28–21	Mulligan & Roach.
136*	Davie	6.99	G	61,733.04	12—4–21	Chandler & Ragland—Hagedorn Const. Co.

*Final Settlement Made with Federal Government

STATUS OF STATE WORK IN NORTH CAROLINA

Projects Under Construction

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	BEGUN	CONTRACTOR
100	Beaufort	10.50	H S	$ 369,777.70	8–23–21	W. T. Hadlow.
105A	Beaufort	2.00	H S	71,680.00	11–11–22	J. L. McGhee Cont. Co.
106	Bertie	7.12	G	58,204.90	9–11–22	J. F. Mulligan Const. Co.–Boney & Hostetler.
113	Chowan	10.32	G	40,975.73	2—1–22	Nello L. Teer—P. R. Ashby.
114	Chowan	10.00	G	45,064.09	1—4–22	Battershill & Goode—Chandler & Ragland.
125	Edgecombe	15.11	H S	428,438.76	2–28–22	R. G. Lassiter & Co.
131	Gates	13.50	G	135,516.01	8–22–22	Bacon & Moore—W. D. Murray—Sadler Corp.
132	Gates	9.73	G	63,921.00	8–29–22	J. A. Marrow.
133	Gates-Pasquotank	14.07	H S	138,050.00	11–14–22	C. W. Lacy—Pittsburg Des Moines Steel Co.
137	Halifax	5.67	H S	124,736.97	10–31–21	O. F. Leighton—A. C. House.
138A	Halifax-Northampton	12.59	G	131,712.13	5—1–22	Nello Teer—Richards Bros.
145	Hertford	12.88	G	86,379.70	7–31–22	Nello Teer—Atlantic Bridge Co.
151	Hyde	4.30	G	71,422.78	12–10–21	C. W. Lacy—Porter & Peck.
154	Martin	11.27	H S	394,090.74	4–17–22	Sou. Willite Paving Co.—O. F. Leighton, Inc.
155	Martin-Pitt	20.00	G	98,176.65	1–12–22	J. P. Dicus—P. R. Ashby.
157A	Martin	12.41	G	90,763.86	10–18–22	Jamison & Bro.—J. A. Marrow.
157B	Martin	12.36	G	90,396.24	11–13–22	J. F. Mulligan Constr. Co.—Batson Cook Co.
159	Nash	11.22	G	89,942.43	1–22–22	J. A. Kreis & Co.
160	Franklin-Wake-Nash	8.93	G	53,722.95	1–27–21	Chandler & Ragland—Southern Dray Co.

STATUS OF STATE WORK IN NORTH CAROLINA—*Continued*

Projects Under Construction (Continued)

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	BEGUN	CONTRACTOR
166	Northampton	0.47	G	$ 17,954.75	3–20–22	W. D. Murray—Sadler Corp.
167	Northampton	20.48	G	87,294.90	7–17–22	Virginia Contr. Co.—Bacon & Moore.
173	Perquimans-Pasquotank	7.22	H S	239,444.70	8–29–22	Williams & Williams.
174	Pasquotank-Camden	2.4	G	55,818.01	4—3–22	D. E. Williams.
175	Pasquotank	9.50	H S	217,405.72	4—6–21	County Commissioners.
183A	Pitt	13.54	H S	390,854.40	11–13–22	S. J. Groves & Sons.
184	Pitt	7.14	H S	206,516.42	11–21–22	Public Service Production Co.
185	Pitt	14.35	G	31,069.72	3–28–22	J. A. Marrow.
186	Pitt	9.75	H S	260,816.60	9–20–21	Cheatwood & Driscoll.
191	Tyrell	6.91	G	57,934.41	1–20–22	C. W. Lacy—M. M. Jones.
195	Washington	15.18	G	65,619.35	2–27–22	L. M. Lee & Co.—B. J. Boyles.
196	Washington	14.93	G	82,099.60	5–15–22	W. H. Thompson—Nello Teer.
200	Carteret	13.68	G	79,629.00	7–21–22	Eagle Eng. Co.—Batson-Cooke Co.
210	Craven	8.34	H S	287,919.38	4—3–22	West Construction Co.—A. P. Gilbert.
211	Craven	9.93	H S	262,673.20	1–30–22	Union Paving Co.
218	Wayne-Duplin	16.06	G	80,804.50	8—4–21	C. W. Lacy.
219	Duplin-Lenoir	15.60	G	148,339.20	6–1—21	Chitwood & Palmer.
227	Greene	6.81	H S	238.113.70	12–19–21	West Construction Co.—Union Paving Co.
236 {F A 143	Johnson	14.83	H S	475,321.55	10–2–22	R. G. Lassiter & Co.
245	Jones	15.76	H S	244,737.90	3–22–22	Hyde & Baxter.
254	Lenoir	....	Bridge	66,740.00	11–22–22	Roanoke Iron & Bridge Co.
263	Pamlico	12.03	H S	289,324.02	3–27–22	Union Paving Co.
264	Craven-Pamlico	0.14	H S	27,156.25	7–24–22	Rhyne & Kitchen.
272	Sampson	16.47	G	98,807.39	6–19–22	R. E. Martin—Striblin—Stauddy & Newell.
280	Wayne	10.01	H S	311,352.36	11–28–21	Union Paving Co.
281	Wayne	....	Bridge	22,484.88	10– –21	P. R. Ashby.
282	Wayne	14.22	H S	352,880.00	11–11–22	Union Paving Co.
291	Wilson	7.63	H S	203,498.18	1–17–22	P. R. Ashby.
294	Wilson	....	Bridge	14,340.00	11–29–22	Stearns Bros.
300	Bladen	11.99	G	65,189.90	4—8–22	T. W. Chandler—Nello Teer.
301	Bladen	13.17	G	82,028.21	11–21–21	J. F. Mulligan—Powell Paving & Const. Co.
312	Brunswick	9.77	H S	247,319.68	7—5–22	Alabama Conc. Prod. Co.—Batson-Cooke Co.
313	Brunswick	3.44	H S	105,389.85	3–15–22	Sou. Willite Paving Co.—Roanoke Bridge & Iron Works.
314	Brunswick	15.82	G	99,326.45	2–23–22	Hagedorn Const. Co.
316	Brunswick	12.12	G	80,068.72	8–14–22	B. Frank Price—Batson, Cooke Co.
325	Columbus	11.22	G	105,258.23	11—3–21	J. A. Kreis-Cornell-Young Co.
326	Columbus	13.61	G	195,838.19	5–23–22	J. T. Plott—J. A. Kreis & Co.
327	Columbus	5.2	G	38,269.44	6–21–22	J. A. Kreis.
338	Cumberland-Sampson	....	Bridge	26,233.99	10–28–21	Roanoke Bridge & Iron Works.
339	Harnett-Cumb'l'nd	....	Bridge	16,524.75	11–30–21	Porter & Boyd.
340	Cumberland	11.07	H S	381,032.02	6–15–22	Alabama Conc. Prod. Co.—Hobbs & Peabody.
364A	Onslow	9.95	G	44,631.40	3–14–22	R. E. Martin.
375	Pender	15.56	G	72,522.92	11–11–21	A. W. McClay.
376	Pender	7.64	G	94,757.85	11–11–21	C. G. Kershaw Const. Co.—Cornell Young Co.
377	Pender-Duplin	1.61	G	76,985.70	3–22–22	R. E. Martin-Hazell-Conerat-Quist Co.
378	Pender	14.12	H S	213,502.96	7–19–22	C. W. Lacy.
379	Pender	10.00	H S	100,000.00	5–22–22	State Forces.
388	Robeson	3.35	H S	137,000.40	11–10–21	C. W. Lacy—Roanoke Bridge & Iron Works.
389	Robeson-Colum	1.56	G	83,463.38	10–26–21	L. A. Chitwood.
400	Chatham	....	Bridge	57,420.22	4–14–22	R. M. Walker & Co.
402	Chatham	6.92	G	33,940.28	8—1–22	J. F. Mulligan Construction Co.
409	Durham	0.5	H S	6,140.64	1–13–22	J. P. Dicus.
411	Durham	5.81	H S	211,574.92	9—1–22	Hutton Eng. & Const. Co.
419	Franklin	12.82	G	63,021.97	7–27–22	Jamison Bros.—J. M. Gregory.
420	Franklin	1.56	H S	55,421.30	7–11–22	Chandler & Ragland.
427	Granville	5.12	H S	159,097.62	12—1–21	R. G. Lassiter & Co.
428	Granville	4.19	H S	132,637.77	7–14–22	Pittman Const. Co.
436	Harnett	21.19	G	144,318.14	6–28–21	C. G. Keeshaw Const. Co.—Hobbs & Kitchen.
445	Lee	5.91	G	18,692.85	5–20–22	C. B. Hester.
446	Lee	5.90	H S	197,188.22	5–24–22	Atlantic Bitulithic Co.—O. A. Mann & Co.
453	Orange	....	Bridge	33,706.80	4–15–22	Geo. W. Kane.
456	Orange	9.00	G	37,459.07	1—7–22	Crawford & Crawford—Nello Teer.
463	Person	11.24	H S	327,171.35	8–14–22	Porter & Boyd.
473 {F A 146	Vance	7.83	H S	265,546.60	7–11–22	R. G. Lassiter & Co.
481	Wake	7.20	H S	252,925.15	1–24–22	Union Paving Co.—P. R. Ashby.
483	Wake	0.54	H S	19,989.75	5–15–22	C. D. Riggsbee.
484	Wake	8.79	H S	311,629.40	8–23–22	P. R. Ashby-Booz-Lloyd & Co.
492	Warren	4.49	H S	100,436.13	4–10–22	Porter & Peck—A. C. House.
493	Warren	3.88	H S	77,866.80	7–27–22	Porter & Peck.
494 {F A 147	Warren	6.21	H S	208,130.01	9—6–22	Clifford Engineering Co.
501	Alamance	13.10	G	32,627.10	12—7–21	W. M. Shook—Hanford Bros.
502	Alamance	17.43	G	138,629.97	7–17–22	W. E. Graham—Hanford Bros.
503	Alamance	....	Bridge	59,450.38	7–17–22	Atlantic Bridge Co.
525	Davidson	10.24	H S	363,141.68	12–23–21	Elliott & Sons & Boggs—Austin Bros. Bridge Co
526	Davidson	3.77	H S	130,826.19	3—4–22	Hagedorn Const. Co.—Heilig & Sherrill.

STATUS OF STATE WORK IN NORTH CAROLINA---*Continued*

Projects Under Construction (Continued)

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	BEGUN	CONTRACTOR
528	Davidson	10.24	H S	$ 427,511.92	10-2-22	Hagedorn Constr. Co.—J. A. Peterson.
532	Guilford	11.70	H S	387,499.20	2—1—22	Elliott-Sholes Co.
533	Guilford-Forsyth	10.50	H S	427,997.62	7-11-21	Royer-Ferguson Const. Co.
535	Guilford	7.78	H S	259,357.01	9-21-22	Leaksville Lumber Co.
539	Guilford	0.164	H S	21,639.20	8—4-22	Robt. G. Lassiter & Co.
544	Hoke	10.45	G	32,445.49	5-16-22	O. A. Mann & Co.—J. T. Pigg.
566	Moore	7.14	G	61,380.66	3—6-22	Gibson Const. Co.—Nello Teer.
567	Moore	2.96	G	7,600.00	4-11-22	C. E. Teague.
569	Moore	18.97	G	97,141.45	8—1-22	Mayfield Const. Co.
577	Randolph	13.37	H S	411,375.77	4-18-22	Royer-Ferguson Co., Inc.—J. L. Brinkley.
588	Rockingham	7.98	H S	266,498.43	4-11-22	Cheatwood & Driscoll.
589	Rockingham	9.81	H S	324,975.31	10-30-22	Cheatwood & Driscoll—Atlantic Bridge Co.
593 {F A 38	Rockingham-Caswell	17.60	H S	525,393.22	7-11-22	J. A. Kreis.
600	Alexander	9.3	G	12,530.98	5-26-22	Bolton Construction Co.
601	Alexander	3.07	G	33,630.45	4—3-22	Gus Ginn, Inc.—R. M. Thurmond.
602	Alexander	9.28	H S	189,329.80	10—9-22	W. E. Graham.
606	Stanley-Anson	....	Bridge	54,759.32	3-23-22	Concrete Steel Bridge Co.
607	Anson	6.39	G	40,517.29	3-21-22	Geer & Wilson—Booz-Lloyd & Co.
608	Anson	7.88	H S	345,408.58	9-18-22	Lampton&Burks—J. A. Peterson.
614 {F A 144	Cabarrus	9.20	H S	350,085.07	6-20-22	A. L. Harris—Oliver & Costello Bros.
622	Catawba	10.85	H S	354,684.88	1-23-22	Union Paving Co.
629	Catawba	8.40	H S	268,662.48	6—5-22	A. L. Harris—R. M. Thurmond & Co.
630	Gaston	3.02	H S	98,392.36	10-21-21	W. F. McCanless.
632	Gaston	9.5	H S	291,868.94	1—2-22	Davis-Wilcox Const. Co.
638	Iredell	7.88	H S	244.509.30	10-12-21	Thompson-Caldwell Co.
639	Iredell	10.59	H S	387,448.42	1—2-22	R. M. Hudson Co.—Luten Bridge Co.
640	Iredell	8.17	H S	181,990.82	9-26-22	W. E. Graham.
647	Lincoln	7.10	H S	250,108.15	6—5-22	A. L. Harris —R. M. Thurmond & Co.
653	Mecklenburg	8.84	H S	308,182.44	1-16-22	UnionPaving Co.—Luten Bridge Co.
654	Mecklenburg	1.01	H S	302,887.09	4—3-22	Lampton & Burks.
655	Mecklenburg	1.57	H S	62,028.68	12-21-21	Speed-Parker Co., Inc.—Luten Bridge Co.
657	Mecklenburg	1.38	G*	20,000.00	12—8-21	State Forces.
661	Richmond	9.76	G	40,683.41	7-18-22	McDonald & Brooks.
665	Richmond	5.77	H S	194,501.23	7-28-22	A. J. Wardrep.
670	Cabarrus-Rowan	4.53	H S	142,221.53	6-29-22	Southern Construction Company.
673	Davidson-Rowan	0.59	Bridge	285,565.20	9-19-22	Hardaway Contracting Co.—Elliott & Sons.
677	Scotland-Robeson	7.11	H S	283,460.21	4-26-22	P.R. Ashby—Chitwood & Palmer.
695	Union	4.5	H S	123,865.28	1-23-22	Redman Const. Co.
700	Alleghany	7.90	G	132,297.33	6-23-21	W. E. Graham.
701	Alleghany-Wilkes	8.00	G*	153,863.60	6-16-21	W. E. Graham.
702A	Alleghany	7.75	H S	209,188.98	10-31-22	O'Brien Constr. Co.—Luten Bridge Co.
711	Ashe	9.5	G	60,000.00	9—7-22	Little Contracting Co.
724	Caldwell	4.66	G	51,890.66	5—8-22	County Road Commrs—R. M. Thurmond & Co.
725	Caldwell	2.4	G	10,000.00	12-29-21	County Commissioners.
731	Davie	5.46	H S	195,393.11	3-13-22	G. R. Martin-Heilig & Sherrill.
741	Forsyth	8.90	H S	315,025.81	7-27-22	Hardaway Construction Company.
742 {F A 137	Forsyth	10.62	H S	385,127.60	6-20-22	Harris Construction Co.
750	Stokes	14.86	G	93,054.38	9-15-21	J. F. Mulligan Const. Co.—Lee J. Smith.
764	Surry	1.63	H S	50,588.20	8-30-22	Leaksville Lumber Co.
765	Surry	3.4	H S	112,685.76	10-24-22	Campbell Constr. Co.
771A	Watauga	0.5	H S	40,000.00	9—7-22	State Forces.
771B	Watauga	3.5	G	75.000.00	9—7-22	State Forces.
780	Wilkes	18.00	G*	25,000.00	7-25-21	J. F. Mulligan.
781	Wilkes	14.50	G*	30,000.00	7-25-21	J. F. Mulligan.
782	Wilkes	5.97	H S	184,614.65	3-29-22	Hyde & Baxter.
783	Wilkes-Watauga	34.40	G*	80,009.00	9—2-21	Chandler & Ragland.
784	Wilkes	4.97	G	85,966.21	8-30-22	J. F. Mulligan Constr. Co.—Foster Constr. Co
790	Yadkin	10.12	H S	308,123.42	4-24-22	Pittman Construction Co.
800	Avery	5.84	H S	198,827.02	7-24-22	O'Brien Const. Co.—J. A. Kreis.
811	Burke	6.0	H S	189,412.41	1-13-22	Southern Dray Co.
814	Burke	8.69	G	13,459.60	8-15-22	M. A. Kollock.
821	Cleveland	1.58	H S	60,192.33	10-31-22	David-Wilcox Constr. Co.
822	Cleveland	10.47	H S	404,378.48	9-27-22	Elliott & Sons—J. A. Kreis.
823	Cleveland	2.0	H S	81,234.01	1-22-22	Southern Paving Co.—Z. B. Weathers & Son.
833	Henderson	10.22	G	38,412.44	1—3-22	S. L. Davis Const. Co.—Asheville Const. Co.
846	McDowell	10.06	G	204,680.74	9-12-21	Asheville Const. Co.—W. T. Taylor Const. Co.
847	McDowell	3.84	G	93,443.90	10-19-22	C. W. Lacy—Oliver & Costello Bros.
855	Mitchell	4.97	H S	174,393.78	9-12-21	Fiske-Carter Construction Co.
856	Mitchell	4.0	H S	239,005.80	3-20-22	Porter & Boyd—L. J. Chandler & Co.
858	Mitchell	....	Bridge	42,367.49	10-2-22	R. M. Thurmond & Co.
860	Mitchell	5.58	H S	152,908.42	4-21-22	J. F. Mulligan—W. H. Anderson Const. Co.
879	Rutherford	....	Bridge	5,737.38	1—9-22	Austin Bros. Bridge Co.
880	Rutherford	....	Bridge	24,679.43	4—4-22	Austin Bros. Bridge Co.
882	Rutherford	15.80	G	89,010.46	9-20-22	Fiske Carter Const. Co.—J. H. Starns.
888	Yancey	15.22	H S	230,499.94	10-10-22	The Luck Co.
903	Buncombe	2.58	H S	100,399.47	4-10-22	Asheville Paving Co.—R. C. Stevens.
904	Buncombe	1.60	H S	81,079.35	3-13-22	Asheville Paving Co.—R. C. Stevens.
910	Cherokee	7.56	G	76,743.59	5-24-21	Ross Bros.—W. T. Moore Conc. Prod. Co.
911	Cherokee	10.33	G	84,475.38	10-25-21	H. A. Wells—Southern Dray Co.

*Reconstruction only.

STATUS OF STATE WORK IN NORTH CAROLINA---*Continued*

Projects Under Construction (Continued.)

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	BEGUN	CONTRACTOR
913	Cherokee	10.33	H S	$ 95,554.80	8—8—22	Mills, Williams Construction Company.
920	Clay	4.8	G	54,875.81	1—9—22	E. A. Wilson & Co.—W. T. Moore Conc. Prod. Co.
921	Clay	12.37	G	123,929.52	10–24–21	Lee J. Smith Const. Co.—W. T. Moore Conc. Prod. Co.
930	Graham	12.90	G	130,522.00	10–15–21	Lee J. Smith Const. Co.—C. M. Dicus.
940	Haywood	7.13	H S	126,082.00	4–14–22	Alexander & Patton—H. A. Brown & Co.
950	Jackson	7.56	G	145,313.30	6–13–21	Wright & Nave—O'Brien Const. Co.
951	Jackson	11.85	H S	249,546.00	8–17–22	R. H. Wright & Sons—W. T. Moore Conc. Prod. Co.
952A	Jackson	10.22	G	164,126.60	8–17–22	Brooks-Calloway Company.
954	Jackson	1.68	H S	90,871.77	7—1–22	Mills, Williams Construction Company.
960	Macon	4.97	G	69,100.57	6—6–21	J. T. Plott—J. E. Lane & Co.
961	Macon	4.77	G	58,340.59	12—5–21	J. T. Plott—J. E. Lane & Co.
962	Macon	13.58	G	171,310.04	4–24–22	O'Brien Const. Co.—Griffin Const. Co.
963	Macon	8.68	G	124,354.01	11-10-22	Costello Bros.—Brooks-Calloway Co.
970	Madison-Yancey	13.80	G	267,378.26	11–11–21	R. H. Wright & Sons—O'Brien Const. Co.
980	Macon-Swain	17.84	H S	350,175.11	....	Costello Bros.—Condon & Condon.
990	Transylvania	8.87	H S	151,238.89	6—5–22	Sam L. Davis Const. Co.—R. C. Stevens.

*Reconstruction only.

Projects Completed

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	COMPLETED	CONTRACTOR
139	Halifax	....	Bridge	$ 18,436.66	8–25–22	Chandler & Ragland—Porter & Peck.
140	Halifax	....	Bridge	10,542.60	5—5–22	Von Glahn & Talbott.
183B	Pitt	....	Bridge	32,343.30	10-16-22	B. J. Boyles.
209	Craven	2.65	H S	15,688.21	2–15–22	Eagle Engineering Co.
255	Lenoir	0.82	H S	33,957.00	8–18–22	West Construction Co.
410	Durham	2.3	H S	83,921.97	2–13–22	C. D. Riggsbee.
454	Orange	4.29	H S	192,006.15	3–16–22	Elliott, Sholes & Teer.
455	Orange	4.19	G	46,415.77	11–28–21	J. F. Mulligan Const. Co.—P. R. Ashby.
482	Wake	6.64	H S	191,669.21	12—8–21	R. M. Hudson Company.
500	Alamance	5.22	G	32,732.20	1–17–22	W. W. Tuck & Son—A. M. Hazell, Connerate—Quist Construction Co.
505	Alamance	0.42	H S	15,346.40	6–23–22	Hedrick Construction Co.
511	Caswell	14.8	G	74,192.58	12–12–21	White & Simpson—C. B. Hester.
692	Union	2.28	H S	65,366.67	12–28–21	Redmon Construction Co.
710	Ashe	3.14	H S	142,687.93	8–17–22	Pittman Construction Co.
719	Caldwell	....	Bridge	5,343.25	6–26–22	Cottrell & Howard.
722	Caldwell	7.00	G*	12,000.00	1–18–22	County Forces.
751	Stokes	7.25	G	31,746.00	10–4–21	W. E. Graham.
760	Surry-Alleghany	6.9	G	24,387.66	11-5-22	W. E. Graham.
801	Avery	9.93	H S	22,350.24	10–26–22	Geer & Wilson.
844	McDowell	1.80	H S	57,048.42	12–28-21	Bolton Construction Co.
845	McDowell	7.19	G	132,177.93	11–22-22	J. W. Stapp Constr. Co.—Praytor, Howton & Wood.
855B	Mitchell	....	Bridge	7,454.15	8–22–22	Luten Bridge Co.
866	Polk	6.00	H S	180,393.40	11–21–22	Southern Paving Co.—Henry Constr. Co.
877	Rutherford	9.79	G	65,563.73	8—7–22	Geer & Wilson.
878	Rutherford	6.55	G	50,913.50	9–22–21	Michaux Const. Co.—Geer & Wilson.
942	Haywood	0.57	G	5,294.46	2—1-22	O'Brien Construction Co.

*Reconstruction only.

PROJECTS UNDER CONTRACT

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	CONTRACTOR
152	Hyde	10.89	G	$ 129,560.00	O. A. Mann & Co.
157A	Martin	12.41	G	90,763.86	Jamison Bros.—J. A. Marrow.
157B	Martin	12.36	G	90,396.24	J. F. Mulligan Construction Co.—Batson, Cooke Co.
183A	Pitt	13.54	H S	399,854.40	S. J. Groves & Sons.
184	Pitt	7.14	H S	206,516.42	Public Service Production Co.
317	Brunswick	....	Bridge	18,893.82	Atlantic Bridge Co.
328	Columbus	7.03	H S	219,371.68	L. L. Tindall.
342	Cumberland	5.91	H S	177,402.50	A. J. Wardrep.
351	New Hanover	10.64	H S	200,006.40	Southern Willite Paving Co.
364B	Onslow	12.84	G	99,819.00	A. W. McClay.
380	Pender	8.98	H S	162,212.60	C. W. Lacy.
386–87	F A-141-2 Robeson	9.86	H S	647,888.05	James O. Heyworth.
412	Durham	8.80	H S	252,582.33	L. L. Tindall.
460	Orange	9.87	H S	296,835.55	R. M. Hudson & Co.
504	Alamance	5.22	H S	154,127.16	Elliott & Sholes.
538	Guilford	....	Bridge	7,039.01	J. L. Brinkley.
545	Hoke	10.45	G	58,195.06	O. A. Mann & Co.—A. W. McClay.

STATUS OF STATE WORK IN NORTH CAROLINA---*Continued*

Projects Under Contract (Continued)

NO.	COUNTY	LENGTH	TYPE	APPROXIMATE COST	CONTRACTOR
546	Hoke	8.0	H S	$ 25,408.00	Dawkins Constr. Co.
589	Rockingham	9.81	H S	324,975.31	Cheatwood & Driscoll.
590	Rockingham	2.10	H S	66,092.18	Geo. R. Martin.
615	Cabarrus	3.88	H S	98,741.17	Thompson-Caldwell Co.
658	Mecklenburg	9.55	H S	270,704.92	Union Paving Co.
665	Richmond	5.77	H S	194,501.23	A. J. Wardrep.
691	Union	....	Bridge	14,837.02	J. S. Brinkley.
693	Union	1.0	G	3,324.48	Sykes-Collins Company.
694	Union	....	Bridge	23,549.13	Hagedorn Construction Co.
712	Ashe	11.06	G	197,687.38	J. T. Plott.
761	Surry	2.22	H S	77,334.02	Geo. R. Martin.
785	Wilkes	2.52	S	78,703.50	D. J. Brookshire & Co.
848	McDowell	....	Bridge	18,597.04	R. M. Thurmond & Co.
858	Mitchell	....	Bridge	42,367.49	R. M. Thurmond & Co.
876	Rutherford	4.83	H S	146,264.80	Fiske-Carter Construction Co.
953	Jackson	12.72	G	118,186.75	C. C. McCabe.

Summary

	NUMBER OF PROJECTS			MILEAGE		APPROXIMATE TOTAL COST		
	H S	G	BRIDGE	H S	G	H S	G	BRIDGE
UNDER CONSTRUCTION								
Federal Aid Projects	2	6	....	9.24	48.14	$ 195,816.88	$ 820,921.47	....
State Projects	101	81	13	719.74	815.68	21,856,268.05	6,420,685.47	$ 710,019.84
Total Under Construction	103	87	13	728.98	863.82	$22,052,084.93	$ 6,999,086.79	$ 710,019.84
UNDER CONTRACT Construction not yet begun								
Federal Aid Projects	....	....	....	....	....	....	....	....
State Projects	15	8	6	105.27	83.73	$ 3,237,086.88	$787,932.77	$125,283.51
Total Under Contract	15	8	6	105.27	83.73	$ 3,237,086.88	$787,932.77	$125,283.51
COMPLETED								
Federal Aid Projects	29	75	4	142.47	713.5	$ 4,745,739.45	$6,576,638.91	$641,946.53
State Projects	11	10	5	40.27	69.46	1,000,435.60	475,423.83	74,119.96
Total Completed	40	85	9	182.74	782.96	$ 5,746,175.05	$7,052,062.74	$716,066.49

Total mileage of Hard Surface work under construction or contracted for	834.25
Total mileage of Topsoil, Sand Clay or Gravel work under construction or contracted for	947.55
Total mileage under construction or contracted for	1781.80
Total cost of Hard Surface work under construction or contracted for	$25,289,171.81
Total cost of Topsoil, Sand Clay or Gravel work under construction or contracted for	8,028,941.03
Total cost of Bridge work under construction or contracted for	835,302.99
Total cost of work under construction or contracted for	$34,153,415.83
Total mileage of Hard Surface work completed	182.74
Total mileage of Topsoil, Sand Clay or Gravel work completed	782.96
Total mileage of work completed	965.70
Total cost of Hard Surface work completed	$5,746,175.05
Total cost of Topsoil, Sand Clay or Gravel work completed	7,052,062.74
Total cost of Bridge work completed	716,066.49
Total cost of all work completed	$13,514,304.28

Corrected to December 1, 1922.

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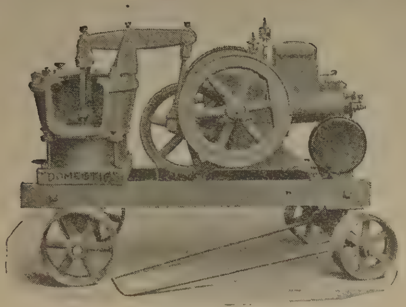

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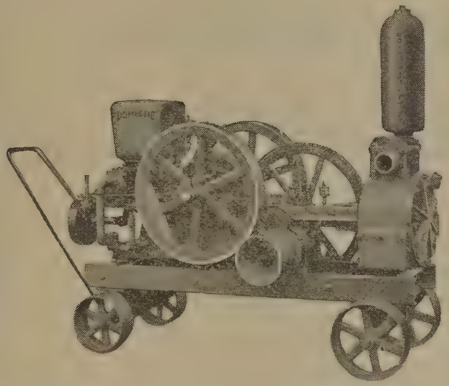

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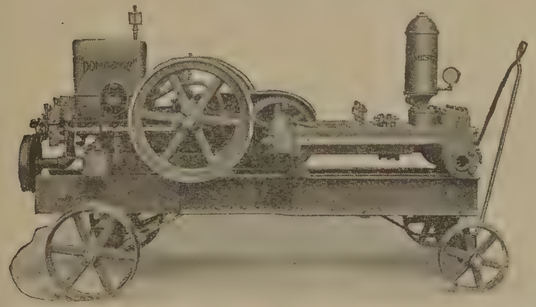
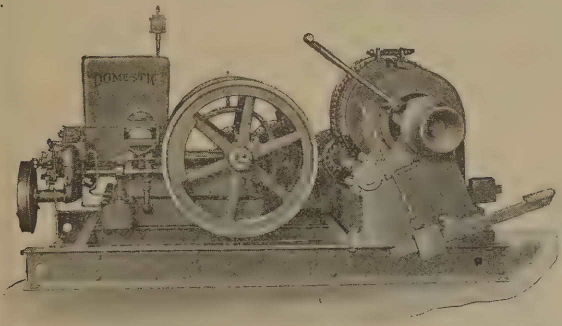


HIGH PRESSURE FORCE PUMPS—For Supplying Water Long Distances to Boilers, Concrete Mixers, Drilling Machines, etc.



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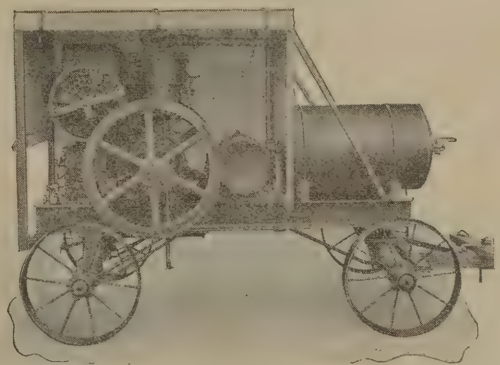

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Permanent Construction Concrete **Minimum Maintenance**

Solves the Road Problem

The concrete road is gaining in favor in all parts of the United States. Whether laid in North or South, East or West, in all varieties of climate and under widely varying conditions, the concrete road is meeting with success and is solving the problem of securing a roadway at reasonable cost that will stand up under modern traffic conditions.

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The most important question in road building today is that of maintenance.

The one aim and desire of road officials and engineers has been to find a material, the use of which would keep maintenance charges at a minimum.

In Bellefontaine, Ohio, the maintenance cost of a concrete road put down 20 years ago has averaged only one-fourth of a cent per square yard per year.

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Concrete, therefore, completely answers the maintenance question.

And this combined with reasonable first cost makes it the ideal material for a modern road to meet modern conditions.

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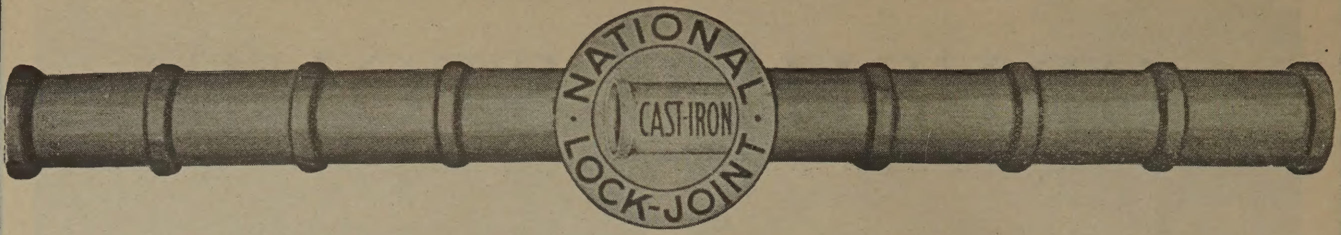

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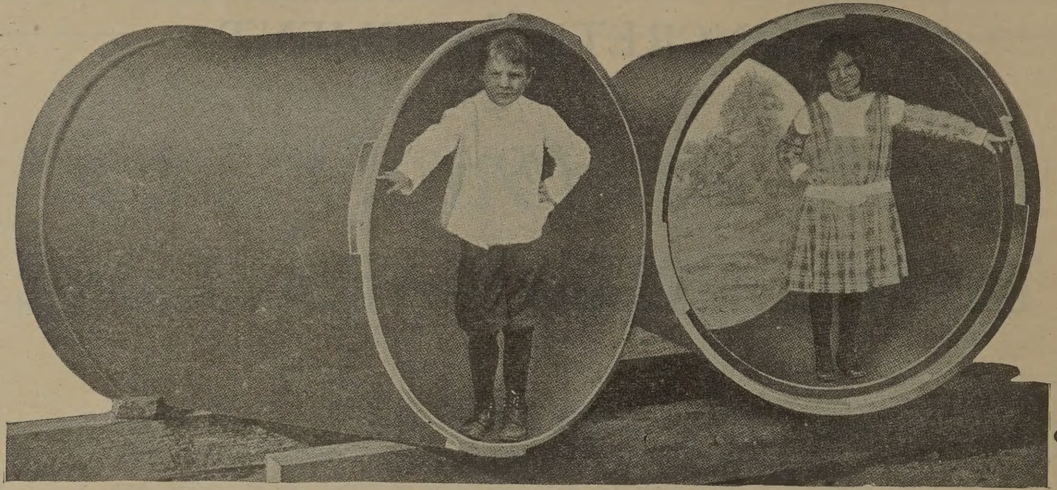

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The pipe which solves culvert renewal problems with least expense, greatest efficiency. The pipe that does not rot or disintegrate, the pipe that is mechanically correct and has proved itself the solution of the culvert problem.

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TWO MEN, without the use of any tools whatsoever, will unload, handle and install all sizes up to and including 36 inches in diameter.

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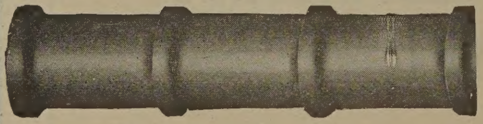

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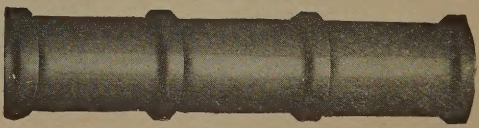

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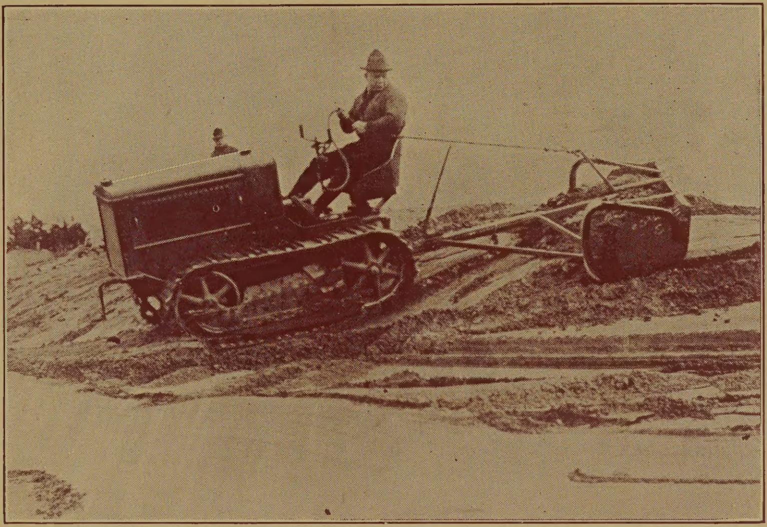

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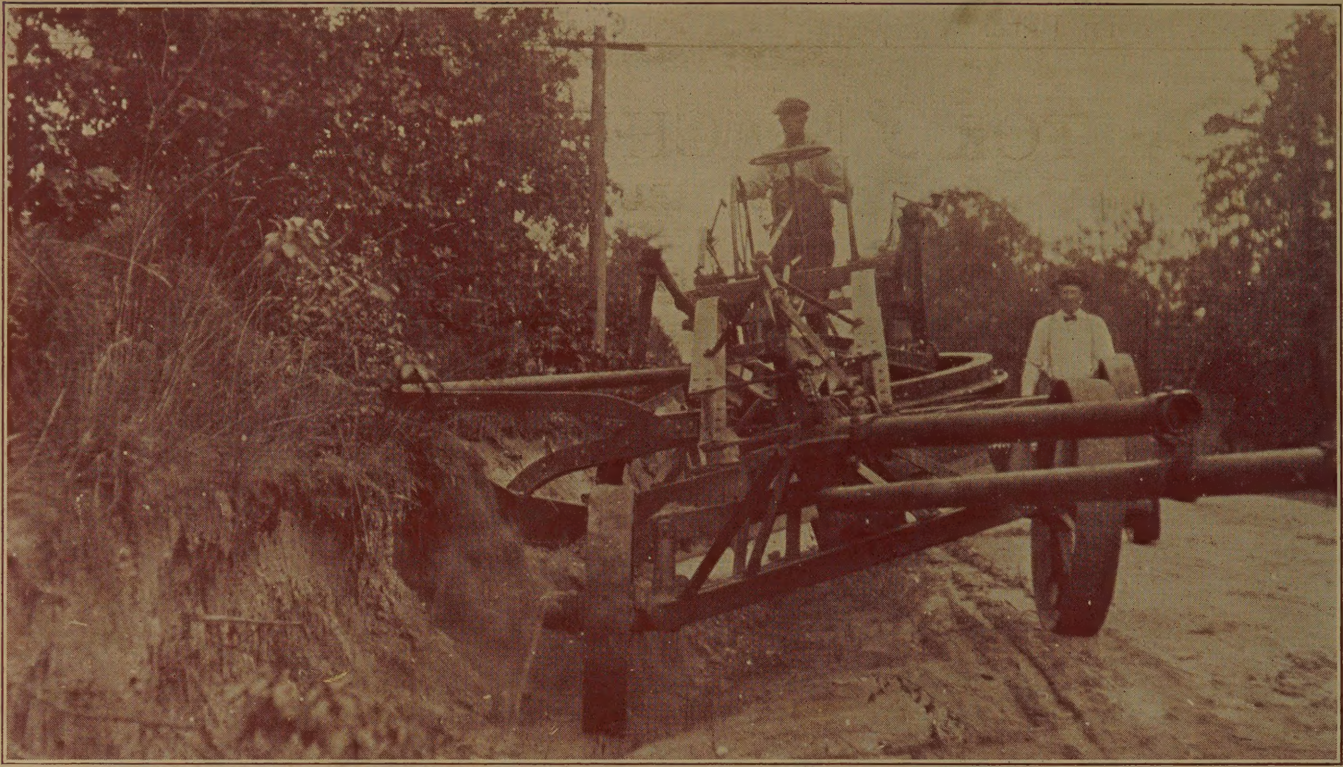

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